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REVIEWS

Edited by KAREN HUNGER PARSHALL

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The Taming of Chance. Ian Hacking. Cambridge/New York (Cambridge University Press). 1990. xiii + 264 pp. $60.00.

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The past five years have seen a virtual explosion of learned historical and epistemological studies of the history of probability and statistics: [Stigler 1986, Porter 1986, Krüger *et al.* 1987, Daston 1988, Gigerenzer 1989, Hald 1990], to name but a few. Hacking was and remains part of this intellectual collective inspired by Lorenz Krüger. As an Anglo-American analytical philosopher with somewhat renegade attractions to French epistemo-archeology and deconstruction, however, Hacking offers a very nontraditional and idiosyncratic account in the present book when compared to his earlier oeuvre [Hacking 1975].

Although very little is said anywhere about formal mathematical concepts of probability, Hacking generally succeeds in identifying and elucidating metaphysical, epistemological, and logical issues which underlie what he considers the ongoing erosion of scientific determinism following "the avalanche of printed numbers ... and the new technologies ... and bureaucracies ... for classifying and enumerating" (pp. 2–3). With something of a Foucaultian perspective [Foucault 1972, 1973], Hacking seeks to examine the emergence of the roots and root-metaphors of what eventually became statistical information and control theory, decision theory and risk analysis, and operations research. He identifies his specific objective as that of philosophically examining the history of the statistical analysis of regularities in societal populations, seen as a particular *mentalité* or "style" of reasoning in the sense of Gaston Granger [1968]. The collection of chronologically

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organized but loosely connected essays seeks to show the ways in which apparently irregular or random events were progressively brought under the control of reconsidered natural and also new social laws, with the notion of chance itself increasingly becoming the conceptual centerpiece. This pride of place was previously held by Newtonian mechanism and its descendants, from Laplace through polyvalent contemporary savants like René Thom [Thom 1983].

The author dates the clearest enunciation of the deterministic view of statistics and probability to Laplace's *Philosophical Essay on Probabilities* [1795], while he finds the first explicit second thoughts and challenges to it in works like Bichot's medical studies, which argue that organic life defies every kind of calculation. Almost concurrent with the French Republic and Empire's emphasis on the use of rudimentary statistics and inference in quantitative medical and epidemiological morbidity studies, was English and German work in anatomo-politics and politico-arithmetic (e.g., Malthus), as well as the first demographic studies such as [Price 1798, Sinclair 1799, Krug 1803]. In Hacking's view, the physiocratic works of Condorcet, the first developer of Bayesian analysis of voting procedures, marked the definite initiation of a recognizable body of probabilistic and statistical methods and applications, if not yet an identifiable academic discipline. During the early 19th century, the two domains of probability and statistics diverged in Auguste Comte's sociological–moral positivism and in the specifically mathematical focus of Adolphe Quetelet. This divergence notwithstanding, the approach to more objective formal statistics and probability in the period from 1800 to 1850 (as detailed in Chaps. 6–10) was still very tentative. Hacking notes the tendency merely to amass huge quantities of data with little quality control and frequently less rigorous analysis. Not uncommon for this era were scientific caricatures such as Quetelet's would-be discovery that Belgian lilacs first bloom when the sum of the squares of the mean daily temperatures following the last frost day adds up to 4264°C! In contrast to Thomas Kuhn's assertion that "the road from scientific law to scientific measurement can rarely be travelled in the reverse direction" [Kuhn 1979, 219], Hacking argues that an explanation of the enthusiasm for measurement and rudimentary graphical and summary statistics, frequently of a very speculative nature, requires a different conception of the historical evolution of ideas.

In trying to cover all of the areas of natural and social science which affected the evolution of pure and applied probability and statistics, Hacking makes not infrequent digressions (such as in Chap. 8 on the sociopathology of 19th-century suicides, and in Chaps. 19 and 20 on psychological normality) which almost obscure more than they illuminate. These are included as early examples of the discovery of apparent statistical laws which were also explained and rationalized in explicitly nondeterministic fashion. As the text constantly stresses, it must be recalled that it was precisely in such a mixed milieu that mathematicians such as Joseph Fourier and his student, Quetelet, further developed the incomplete generalizations of Bernoulli and Laplace through applications.

To offer a sense of these applications, Chapter 10 discusses the use of statistical data in evaluating the efficacy of medical treatments, while Chapter 11 examines

Poisson's efforts to design optimally selected and sized court trial juries. In Chapter 12, Hacking details Poisson's 1837 work leading to the Law of Large Numbers, which, he underscores, was metamathematically poised between subjective (belief-based, inferential) and objective (frequency-, modeling-, choice-based) attitudes toward probability. Even though many of Poisson's contemporaries vigorously argued that the Law of Large Numbers was nothing but a minor explication of Bernoulli's work, no one before Chebyshev (1859) seems to have been bothered by the question of whether it was "really" an empirical phenomenon or a mathematical theorem. Chapter 13 also shows how Quetelet's studies of racially representative average morphological traits helped not only to transform the notion of arithmetic mean into a recognized quantity but also to develop the measurement of unknown physical quantities into a measurement *theory* for abstract properties of populations (for example, the Gaussian distribution).

Chapters 16 and 17 chronicle some of the antistatistical backlash from scientific, philosophical, and literary quarters. For example, Hacking addresses the seemingly contradictory thesis of Ernst Cassirer [1956, 3] that scientific determinism—as an explicit idea linked to that of causal necessity—arose only around 1870. Although Hacking rejects the *prima facie* implications of Cassirer's thesis, he argues that the words "determinism," "necessity," and "chance" did not have their present (nonmetaphoric) philosophical meaning until the latter part of the 19th century. Citing the references to the French neo-Kantians, Renouvier and Delboeuf, in William James's 1884 lecture "The Dilemma of Determinism" and James Clerk Maxwell's later inferences against free will, Hacking finds the origins of a strong notion of determinism in the 1850's in France and the 1880's in England (rather than the 1870's in Germany).

The book next moves, in Chapter 20 and especially in Chapter 21, to a discussion of the belief in *sui generis* statistical laws as real and autonomous cosmic forces. Here, Hacking argues that the taming of chance hinged critically on probability and statistics becoming routinely servicable for explanation as well as prediction of scientific phenomena. He focuses on the statistical work concerning genetic inheritance by Galton and on the research of Karl Pearson (founder of *Biometrika* and *Annals of Eugenics*). Using his "quincunx" machine, Galton demonstrated that, if a population is normally distributed, in a second generation there will be a normal distribution of similar mean and dispersion in which exceptional members will not typically be descended from exceptional members of the prior generation. Pearson, particularly in his philosophical writings, considered that "correlational" explanations such as Galton's practically eliminated the need for a metaphysical notion of causality.

Returning to the opening theme of Chapter 1, Hacking closes this book with a survey of the (meta) scientifically brilliant albeit personally tormented career of Charles Sanders Peirce, which, in many ways, is also a summary of the later evolution of key concepts in the protomathematical disciplines of probability and statistics. He touches on Peirce's work on accuracy in geodetic measurement and errors in physical observation, the nature of psychophysical regularities, and his belief in an ultimately self-correcting scientific community of communicators, as the semiotic medium for and the arbiter of scientific (including statistical and probabilistic) inference. Peirce [1931–1935 II, 650–700] refused the subjectivism of those who, like Augustus de Morgan, construed probabilities as degrees of belief. Denying determinism outright, Peirce explained inductive learning and reasoning in terms of statistical stability over a total community of "interpretants" [Peirce 1931–1935 V, 330–540; VII, 216], a notion from Peirce's semiotics that is far from clear in his own writing and remains a topic of considerable investigation [Apel 1981]. As Hacking rightly summarizes, Peirce's pragmatistic concept of reality made the notion of an (asymptotically approached?) truth a strongly probabilistic matter of what is discovered over the long term in the community of scientific interpretants as a whole.

For readers troubled by the often redundant, patchwork, and at times disorderly progress of this narrative, Hacking replies that the history of the development of probability and statistics was itself disorderly, and that most prior historiographical and philosophical models have only imposed a false systematization. In contrast to Stigler's meticulously detailed study, Hacking's book tends to underline larger crosscutting historical and philosophical themes. On the question of philosophical styles, Hacking's prose as well as his themes are much influenced by the rather loose, extremal, and occasionally self-reflexively sarcastic styles of contemporary French philosophers such as Michel Foucault and Michel Serres, and of sociophilosophers of science such as Bruno Latour [1986]. Thus, there is little philosophically detailed discussion of what Cassirer [1956, 193ff] called the struggle between interpreting probabilities as either modal/empirically possible or categoric theoretical explanations. *The Taming of Chance* is written in an easy and readable semitechnical fashion and can be read as a kind of culmination of the above-noted recent studies on the history of statistics and probability. Unfortunately, some of this material has appeared previously in a somewhat similar form [Hacking 1980], which diminishes the originality of the present monograph. Although it is not the place for a beginner to get conceptual and chronological bearings, this book has a definite place in university and philosophy libraries, and will offer many points for reconsideration and debate to mathematicians and future scholars in the history and philosophy of mathematics.

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Mathematische Schriften, 7th Ser., Vol. 1. By G. W. Leibniz; edited by Eberhard Knobloch and Walter S. Contro. Berlin (Akademie-Verlag). 1990. 954 + xxxix pp.

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Leibniz produced a staggering amount of work in such areas as philosophy, law, mathematics, logic, history, linguistics, mechanics, physics, astronomy, and theology. The present collection gives some indication as to the scope of his contributions. It is just the first volume in the Leibniz-Archiv (Hannover) project to produce all of Leibniz's mathematical writing. Its nearly one thousand pages represent his writings on certain mathematical subjects during the four years from 1672 to 1676 which Leibniz, then in his twenties, spent in Paris. (Note that this does not include the extensive body of Leibniz's work on the calculus.) Leibniz was the paradigmatic example of genius during a century which Whitehead called the "century of genius" [1889, p. viii]. While Leibniz always claimed that logic was the foundation of all of his ideas from theology to mathematics, he had few other logicians with whom he could discuss or debate his logic (the "universal characteristic"). In most other areas of research, however, this was far from the case. Leibniz may have been isolated as a logician, but as a mathematician he